AYUSHDHARA
ISSN: 2393-9583 (P)/ 2393-9591 (O)
An International Journal of Research in AYUSH and Allied Systems

Review Article

THE THERAPEUTIC AND TOXICOLOGICAL EFFECT OF *CHITRAK* (*PLUMBAGO ZEYLANICA* L.)- A REVIEW

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Article info

Article History:
Received: 14-07-2015
Accepted: 10-09-2015

KEYWORDS: *Chitraka, Plumbago zeylanica* L., Plumbaginaceae.

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ABSTRACT

Chitraka based Ayurvedic medicines are commonly used by *Ayurvedic* physicians. *Chitraka* is toxic in nature even then it is used as a medicine after *Shodana* (purification) and in therapeutic dose. *Shodhana* procedure is not only represent a process of purification, but also in addition to a process of detoxification and the ultimate objective of *Shodhana* is to enhance the biological efficacy of the drug.In therapeutic doses it has capacity to treat many diseases. Traditionally *P. zeylanica* is used as a stimulant, digestive, expectorant, laxative, abortifacient, antiperiodic and in the treatment of muscular pain, intestinal parasites, anemia, dysentery, fever or malaria and rheumatic diseases. *P. zeylanica* contains a variety of important chemical compounds. Different parts of the plant possess naphthaquinones, alkaloids, glycosides, steroids, triterpenoids, tannins, phenolic compounds, flavanoids, saponins, coumarins, carbohydrates, fixed oil and fats and proteins. Its fruits contains plumbagin, glucopyranoside and sitosterol. There are so many researches has been done on this plant like Anti-carcinogenic activity, Anti-diabetic, wound healing, contraceptive effect, Hepato-protective, Anti-microbial, Anti-inflammatory and Anthelmintic. This review gives us opportunity to understand the toxic effects, medicinal importance, biological activities and pharmacological effects of *Plumbago zeylanica*. This article gives an overview of medicinal uses and poisonous properties of *Chitraka*.

INTRODUCTION

The world is endowed with a rich wealth of medicinal plants[1]. Medicinal plants are the main constituents of many of drugs of Indian system of medicine[2]. Natural products play an important role in drug development programs in the pharmaceutical industry[3]. Nature has been a source of medicinal agents for thousands of years and an impressive number of modern drugs have been isolated from natural sources, particularly from plants. Various medicinal plants have been used for years in daily life to treat diseases all over the world.

Plumbago zelanica L. (chromosome number 2n=24) is a multipurpose medicinal herb of family Plumbaginaceae. *P. zeylanica*is the most common plant used in India as traditional system of medicine. A native of South Asia, the species is distributed throughout most of the tropic and subtropics; growing in deciduous woodland, savannas' and scrub lands from sea level up to 2000 m altitude.[3-5] The root is used as laxative, expectorant, astringent, abortifacient and in dysentery. Tincture of root bark is used as antiperiodic. The leaves are caustic and used in treatment of scabies. Plumbago are chemically characterized by the presence of naphthoquinones flavonoids, terpenoids and steroids, many of them being responsible for several biodynamic activities.[6] *Chitraka* means the 'spotted one', perhaps referring to its name sake, the spotted leopard, who speedily catches its prey just as *Chitraka* rapidly cures diseases. It is also known as *Agni* meaning 'fire' or Jvala meaning 'flame'. It is a very hot-natured herb and should be used sparingly. It strongly increases the digestive fire. The leaves of *Plumbego zeylanica* are widely used medicinally in India and China. Traditionally, *P. zeylanica* is believed to kill intestinal parasites, and it is used clinically to treat rheumatism, intestinal parasites, anemia due to "stagnant blood", external and internal trauma, toxic swelling and malignant furunculous scabies (Jiangsu, 1979). In India it is usually used to treat fever or malaria. [7]

MORPHOLOGICAL DESCRIPTION

Habit: A rambling sub-scandent perennial herb or under shrub with green branches.[6]

Roots: 30 cm or more in length, 6 mm or more in diameter, stout, cylindrical, friable, straight un-branched or slightly branched with or without secondary roots, with uniform and smooth texture.[6] they are light- yellow when fresh and become reddish-brown on drying. The roots have a strong and characteristic odour with acrid and bitter taste. [7]

Stems: Somewhat woody, spreading, terate, striate, glabous. It attains a height of about 0.5–2 m (1.6–6.6 ft). Bark is thin and brown in colour.[8]

Leaf: Simple, alternate, 8cm long and 3 cm broad, ovate, Subacute, entire, glabrous, petiole narrow, amplexicaul at the base and often dilated into stipule like auricles.[8]

Inflorescence: Terminal raceme-type about 6-30 CM Long and many-flower.

Flowers :In elongate spikes, rhach is glandular, striate braceteoles ovate

Fruit: Fruit of the plant is an oblong (7.5–8 mm long) five-furrowed capsule containing single seed. Each seed is oblong in structure, 5-6 mm.

long and reddish- brown to dark brown in colour.

calyx- 1-1.3cmlong,narrowly tubular, densely covered with stalked glands.[9]

Ovary : Ovary is always superior, 5-gonous, one celled, ovule one, basal. [10]

***Ayurvedic* review**

Synonyms[11]

Sanskrit	:	Agni, Vahni, Jvalanakhya, Krsanu, Huasa, Dahana, Hutabhuk, Sikhi
Assamese	:	Agiyachit, Agnachit
Bengali	:	Chita
English	:	Lead war
Gujrati	:	Chitrakmula
Hindi	:	Chira, Chitra
Kannada	:	Chitramula, Vahni, Bilichitramoola
Kashmiri	:	Chitra, Shatranja
Malayalam	:	Vellakeduveli, Thumpokkoduveli
Marathi	:	Chitraka
Oriya	:	Chitamula, Chitoparu
Punjabi	:	Chitra
Tamil	:	Chitramoolam, Kodiveli
Telugu	:	Chitramulam
Urdu	:	Sheetraj
Hindi	:	Cheetah

Physical properties

Ras	:	*Katu*
Guna	:	*Laghu,Ruksa,Tiksna*
Vipak	:	*Katu*
Virya	:	*Ushna*

Classical Categorization

***Charak**: Dipanya, Sulaprasmana, Arsoghna, Lekhanya*

***Susruta**: Pippalayadi, Mustadi, Amalakyadi*

***Vagbhata**: Pippalayadi, Mustadi, Varunadi, Aragvadhadi.*[12]

Charaka described it as the best drug to cure *Gulamroga, Arshas* and *Shoola*.[13]

In the contest of *Rasayana Sushruta* advocated the utility of *Chitraka rasayana* similar to that of *Bakuchi rasayana*.[14]

Vaghbhata delineated three varieties of *Chitraka* and quoted them for *Rasayana* purpose.[15]

In *Lolambarariyam* (*Sadvaidyajivanam*) *Chitraka* is indicated as the best vehicle in case of *Arshas.*

Charaka used the terms *Chitra, Chitraka* together under *Bhedaniya dashaimani.*

Chitraka described here may be a variety of *Eranda* (as *Charaka* mentioned two types of *Eranda*). *Rajanarahari* described *Rakta chitraka* for *Paradaniyamana* and *Lohavedhana*. This variety of *Chitraka* is claimed to be useful to gain weight and strength for the human body.

Chitraka is the one of the main ingredient in *Thrimada*, *Panchakola* and *Sadooshana*.[13]

Types

Vagbhata quoted three varieties of *Chitraka*

1. *Shwetha*
2. *Peeta*
3. *Asita*

Rajanighantu the second variety of *Chitraka* i.e *Rakta Chitraka* is denoted as *Kalaha*.

Usually the following varieties are found. [16]

1. *P. Zeylanica*- White
2. *P. rosea* L. Red

For all therapeutic purposes, *Plumbago zeylanica* or the white variety is used.

Traditional Medicinal Uses of *P. Zeylanica*

The whole plant has medicinal effects but the root of *Chitrak* has therapeutic uses. Plant pacifies vitiated *Vata*, *Kapha*, diarrhea, inflammation, fever, nervous palsy, hemorrhoids, skin diseases, irritable bowel disease, epilepsy, amenorrhea and anemia. according to Paiva et al., (2003) flowers are used as digestant[17]. Leaves are caustic, vesicant, aphrodisiac, good for scabies stimulant and are also used in sore and swelling [18]. They are used to treat infections and digestive problems such as dysentery. Externally a paste is applied to painful rheumatic areas or to chronic and itchy skin problems[19]. Pharmacological studies have indicated that *P. zeylanica* extract has antiplasmodial[21] antimicrobial [21] antifungal[22] anti-inflammatory[23] antihyperglycemic, hypolipidemic and antiatherosclerotic activities. Root is bitter, laxative, expectorant, tonic, abortifacient, good appetizer, useful in rheumatism, laryngitis, scabies and disease of spleen[24]. According to Chunekar its roots are mixed with *Abrus precatorius* and used in leucoderma[25]. It is

also used as one of 10 constituents of '*Kaphaj-Prameh Nashak Dus Yog'* in urinary disorders due to '*Kapha'* [26]. It augments the appetite, improves digestion, relieves constipation and alleviates the urticaria- the allergic skin rashes[27]. The properties of *Citraka* are.

Vahnikrut: Improves digestion strength.

Pachana: Digestive.

Laghu: Light to digest.

Grahanihara: Relieves sprue, malabsorption syndrome.

Kushtahara: Useful in skin diseases.

Shothahara: Anti inflammatory.

Kruminut: Useful in intestinal worm infestation.

Kasanut: Useful in cough, cold.

Grahi: Absorbent, absorbs excess moisture from intestine.

Vatarsha: Useful in hemorrhoids of *Vata* origin (with pain).

Grhani: *Chitrakadya gutika* and *Chitraka ghrita*.

Arshas: *Chitraka* and *Sunthi* are made as paste by mixing with *Kanjika* and applied locally.

Sukrameha: *Chitrakakasaya* is useful.[28]

Svitra: *Chitraka* and *Trikatu* are mixed with honey and cow urine should be kept in a jar coated with ghee for a night and taken orally.

***Atisar*:** *Chitrakamool* paste with *Takara.*

Kustha: *Chitrakamool* powder with water.

Medoroga: *Chitrakamool* powder with honey[29]

Pandu: *Balamoola* and *Chitraka* 10 gm to be taken with warm water or *Shigrubeeja* mixed with equal salt keeping on milk diet.

The roots of plant are used with honey in obesity.

The roots are also given in filariasis.

The root decoction is orally useful in anemia. [12]

Part Used: Root Bark and leaves.

Dosage-powder-1-2gm

Vishishta yoga

1. *Chitrakadi gutika* (Ch.S.Chi.15)
2. *Chitrakadi leha* (Ch.S. Chi.18)
3. *Chitrakadi ghrita* (Chakradatt 4)
4. *Chitraka rasayana* (Shu.S.Chi 28)
5. *Chitrakadi choorna* (Sharandhar madhayam kand 56)
6. *Chitrakadi lep (Ch.S.Chi 7)*
7. *Punarnava mandur (Chi.S.Chi.16)*
8. *Yograaj (Ch.S.Chi. 16)*
9. *Vyoshadi gutika (Sha.S.Madhayam khand 7)*
10. *Aryogyovardhini vati* (*Rasratn samucchaya kusthe)*
11. *Chandraprabha vati (Bhaishjay ratnawali premeh)*

Chemical Properties

P. zeylanica contains a variety of important chemical compounds. Different parts of the plant possess naphthaquinones, alkaloids, glycosides, steroids, triterpenoids, tannins, phenolic compounds, flavanoids, saponins, coumarins, carbohydrates, fixed oil and fats and proteins.[3,29,30]

Fruit: It contains plumbagin, glucopyranoside and sitosterol. Seeds: Seeds contain plumbagin.

Roots: The root bark of P. zeylanica contains plumbagin. The root yield new pigment, viz, 3-chloroplumbagin, 3, 3-biplumbagin, binaphthoquinone identify as 3', 6'-biplumbagin, and four other pigments identify asisozeylanone, zeylanone, elliptinone, and droserone 2, 3.The isolation of plumbagin, droserone, isoshinanolone and a new napthalenone i.e., 1, 2 (3)-tetrahydro-3, 3'-plumbagin is reported from the phenolic fraction of the light petrol extract of the roots. Two plumbagic acid glucosides; 3'o-beta-glucopyranosylplumbagic acid and 3'-o-beta-glucopyranosyl plumbagic acid, methyl ester along with five naphthaquinones (plumbagin, chitranone, maritinone, elliptinone and isoshinanolone), and five coumarins (seselin, methoxyseselin, suberosine, xanthyletin and xanthoxyletin) were isolated from the roots.[31]

Plumbagin

Plumbagin (5-hydroxy-2-methyl-1, 4-naphthoquinone- C11-H8-O3) is present in roots of the plants. It self-contained 1% present in entire plant. So plumbagin store in root majorly, plumbagin is a rationally stirring yellow pigment that patents in members of Plumbaginaceae and that too customarily in roots[32]. The stem has a lesser volume and leaves has no plumabgin. It is natural yellow pigment because of existence of naphthoquinone pigment[33] and is existing in the form of needles. Plumbagin is soluble in alcohol, acetone, chloroform, benzene, and acetic acid. and is exceedingly toxic compound with corrosive possessions. Plumbagin has antibacterial activity in contradiction of numerous pathogenic bacteria. The methanolic extract of plumbagin shows strong antibacterial activity against *Escherichia coli, Salmonella typhi* and *Staphylococcus aureus*[34].

Toxicity

The roots of these plant contain an active principle plumbagin, a highly acrid crystalline glycoside, which exists as fine glistening needles of a golden yellow colour. It is insoluble in cold water, moderately soluble in hot water and freely soluble in ether, chloroform, alcohol and benzene. plumbagin is a powerful irritant and has a well marked germicidal action on bacteria and unicellular organism. when the bruised root or twings are applied externally, the skin becomes red and vesicates. Taken internally in small doses, the plant acts as a sudorific and stimulates the

contraction of the muscular tissue of the heart, intestine and uterus. Taken internally in large doses, the plant acts as an irritant poison and produces abdominal colicky pain. Other symptoms are dilated pupils, itching of the skin which becomes reddened and is covered with perspiration. hypotonia and slow or irregular pulse and gasping respiration. myotonia, collapse and death from respiratory failure.[35]

Fatal dose-178gm of powdered

Fatal period is not certain.

Medico legal aspects: The root is ingested as an abortifacient or applied to the -cervix directly or as a paste via the abortion stick. Malingerers use it to produce artificial bruise. it is rarely used as a homicidal poison.[36]

Treatment

1.Gastric lavage with warm water

2.Administration of demulcents, stimulants and other drugs as indicated by the symptoms.[36]

3.Oxygen and artificial respiration is to be given if necessary.

4.About 2mg of atropine should be given for broncho-spasm and slow pulse.[35]

Antidote

Pittashamaka, *Snighda*, and *Sheeta* preparations should be given. Example -*Kshira* and *Chandana*.[37]

Rakta Chitraka Sodhana (purification) (Rasatarangini, Taranga 24; 575.)

Small pieces of *Citraka mula* are soaked in lime water and thereafter washed, dried under the sun.[37]

Pharmacological Activities

1. Anti-bacterial activity

The alcoholic extract from roots of *Plumbago zeylanica*was tested against multi-drug resistant of clinical origin (*Salmonella paratyphi, Staphylococcus aureus, Escherichia coli* and *Shigella dysenteriae*). The extract exhibited strong antibacterial activity against all tested bacteria.[38]

2. Antioxidant activity

Zahin et al. (2009) carried out in vitro antioxidant activity and total phenolic content of methanolic extracts of *P. zeylanica* (root), *A. calamus* (rhizome), *H. indicus* (stem) and H. antidysenterica (bark). The order of antioxidant potential according to FTC assay was found to be highest in *P. zeylanica.* Natarajan et al. (2006) carried out antioxidant activity.[39]

3. Anti arthritic activity

Poosarla and Athota (2007) investigated the role of an ethyl acetate fraction of the root extract of *P. zeylanica* in its antiarthritic activity in collagen type II–induced arthritis in DBA/1 mice and in the suppression of humoral antibody and stimulation of T cell mediated responses. PZE-6 suppressed collagen type II–induced arthritis in DBA/1 mice in a dose-dependent manner. In addition, the treatment with *P. zeylanica* stimulated Con A induced T-cell proliferation to normal levels in arthritic mice.[40]

4. Anticarcinogenic Activity

Male F344 rats, administered with plumbagin at 200 ppm in the diet for two weeks beginning one week before azoxymethane (AOM) injection had a lower incidence and multiplicity of tumors in the small intestine than those administered AOM alone. This suggests that plumbagin could be a promising neoplasia. Hexokinase, phosphoglucoisomerse and aldolase levels increased in hepatoma-bearing rats, but they decreased to near-normal levels in animals administered plumbagin. Levels of the gluconeogenic enzymes, glucose- 6-phosphate and fructose -1, 6-isphosphatase decreased in hepatoma bearing animals, but increased in the animals treated with plumbagin[41].

5. Toxicity studies

Teshome et al. (2008) carried out toxicity studies on dermal application of plant extract of *P. zeylanica* used in Ethiopian traditional medicine. Repeated dose toxicity test was associated with increased relative testis weight ($P < 0.05$) as well as higher values for blood urea nitrogen and K+ ($P < 0.05$) in both sexes with the highest dose (1000 mg/kg) group, although histo-pathological analyses failed to lend support to these observations. Taken together, the dermato-toxicity test results from this study suggest that P. zeylanica toxic effects might be limited to effects like moderate irritation.[42]

6. Antidiabetic activity

Christudas Sunil and et al. also evaluated the antidiabetic effects of plumbagin isolated from P.zeylanica root and its effect on GLUT4 translocation in TZ-induced diabetic rats.[43]

7. Antifungal Activity

Alcoholic extracts of *Plumbago zeylanica* showed strong antifungal against the pathogenic yeast, Candida albicans and dermatophytes, Epidermophyton floccosum, Microsporum gypseum and Trichophyton rubrum, Minimum inhibitory concentration (MIC) was found to be 4 mg/ml. [44]

8. Antiviral Activity

Examined the antiviral activities of the 80% methanolic extracts of *Plumbago zeylanica* against Coxsackie Virus B3 (CVB3), influenza A virus and herpes simplex virus type 1 kupka (HSV-1) using cytopathic effect (CPE) inhibitory assays in HeLa, MDCK and GMK cells respectively. The antiviral activity of the most active compound was confirmed with plaque reduction assays. They also found that CVB3 was inhibited by the extract of *Plumbago zeylanica.*[45]

9. Antiplasmodial Activity

Plumbagin shows antimalarial effects on Plasmodium falciparum enzyme, the succinate dehydrogenase (SDH). The activity has been 50% inhibited by the naphthoquinone plumbagin at an inhibitory concentration of 5 mM. It also inhibited the in vitro growth of the parasite with a 50% in an inhibitory concentration of 0.27 mM [46].

10. Hypo-lipidaemic activity

Alpana (1996) studied effect of *P. zeylanica* in hyper-lipidaemic rabbits and its modification by vitamin E. There was significant reduction in serum total cholesterol, LDL cholesterol and triglyceride levels. Marked reduction was observed with the formulation of *P. zeylanica* and vitamin E. The total cholesterol/HDL and LDL/HDL cholesterol ratios were found significantly ($p<0.01$) decreased [47]

CONCLUSION

From the beginning of human race, the plants are being employed by the people for their therapeutic uses and still we tend to have faith in their disease curing properties. Though *Chitraka* is taken into account as a toxic plant, it has been used for thousands of years in Ayurvedic medication after purification. The various experimental studies on *Plumbago zeylanica* has shown its different activities such as, Anti-viral, Anti-fungal, Anti-cancerous, hypo-lipidemic, Hypo-glycemic and Anti-plasmodial and Anti-oxidant effect.

However most of the therapeutic properties are proved in animal experiment model, therefore it is very necessary to conduct controlled clinical studies so that more clinical data in support of effectiveness of medicine can be collected.

REFERENCES

1. Chanana GL. Standardisation and Quality control, In Devendra Sharma (ed.), compendium on Phytomedicines, council for development of Rural Areas, Gramin Chhetriya vikas Parishad, 2, Vigyan Lok, Vikas Marg Extn, Delhi, 1997, 323-326.
2. Baker JT, Borris RP, Carte B. Natural products drug discovery and development. New perspective on international collaborations. Nat prod 1995; 58:1325-1357.
3. Vijver, LM, Antibacterial Activity In Roots of Plumbago zeylanica, Planta Med, 20, 1971, 8-13.
4. Aditi G, Medicinal plants used in traditional medicine in Jimma zone, South West Ethopia, Pharm. Biol., 37, 1999, 321-323.
5. Vishnukanta, Evaluation of anticonvulsant activity of Plumbago zeylanica Linn leaf extract, Asian Journal of Pharmaceutical and Clinical Research 3(1), 2010, 76-78.
6. Paras Jain, H. P. Sharma, Fauziya Basri, Binit Baraik, Soni Kumari, Chanchala Pathak Pharmacological Pharmacological Profiles of Ethno-Medicinal Plant: *Plumbago zeylanica* L.- A Review Int. J. Pharm. Sci. Rev. Res., 24(1), Jan – Feb 2014[7].
7. Chetty KM *et al.* [2006] Pharmaceutical studies and therapeutic uses of *Plumbago zeylanica* L. root Ethnobotanical Leaflets. 10: 294-304.
8. D.A. Dhale and S.K. Markandeya, Antimicrobial and Phytochemical Screening of Plumbago zeylanica Linn. Plumbaginaceae) Leaf. Journal of Experimental Sciences Vol. 2, Issue 3, Pages 04-06 [2011].
9. Anilkumar, Dhiman. Ayuredic drug plants, Daya publication, 2006. pp.205
10. Ahmad I, Aquil F. In vitro efficacy of bioactive extracts of 15 medicinal plants against Esbetal-producing multidrug-resistant enteric bacteria. Microbiol Res., 2006; 162(3): 264-275.
11. Ayurvedic pharmacopoeia of India, first part, first volume, page no.39
12. Madanpal nighantu, Dr.J.L.N. sastry, first edition,. Varanasi: Chaukhamba Bharati Academy, sunthyadi varga, Chapter 2, page no.105.
13. Charak samhita chikitsasthan (12/59) Pandit kashinath shastri edition re print Chaukhambha publication, Varanasi 2011;868-870.
14. Sushrutsamhita, uttartantra (44/26) Ambikadatt sahastri, edition, Reprint chaukhambha publication Varanasi 2011;35.
15. Astang hradiyam uttarsthan (39 62) Sarwang sundari vakhaya, lalchand vaidh, chaukhambha publication, Varanasi, 2009, pp.250
16. Sharma PV. 8th edition Vol. 2. Varanasi: Chaukhamba Bharati Academy; 1986. Dravyaguna Vigyana; pp. 359-362.
17. Paiva SR, Marques SS, Figueiredo MR, Kaplan MAC. Plumbaginale: A Pharmacological approach. Florestae Ambiente 2003; 10:98-105.
18. Sharma PC, Yelne MB and Dennis T. Data Base on Medicanal plant used in Ayurveda. Central Council for Research in Ayurveda and Siddha, New Delhi, 2001. pp.220
19. Mukherjee PK. Quality Control Herbal Drugs, an approach to evaluation of Botanicals. Business Horizones, New Delhi, 2002.
20. Simonsen HT, Nordskjold JB, Smith UW, Nyman U,Palpu P, Joshi P *et al*. *In vitro* Screening of Indian medicinal plants for anti-plasmodial activity. Journal of Ethnopharmacology 2001; 74:195-204.
21. Ahmad I, Mehmood Z, Mohammad F, Ahmad S.Antimicrobial potency and synergistic activity of five traditionally used Indian Medicinal plants. Journal of Medicinal and Aromatic plant Sciences 2000; 23:173-176.
22. Mehmood Z, Ahmad I, Mohammad F and Ahmad S.Indian Midicinal plant: A potential source for anti-candidal drug. Pharmaceutical Biology 1999; 37(3):237-242.
23. Oyedapo OO. Studies on the bioactivity of the extract p*lumbago zeylanica*. Phytotherapy Research 1996;13:346-348.
24. Olagunju JA, Jobi AA, Oyedapo OO. An investigation into the biochemical basis of the observed hyperglycemia in rats treated with

ethanol root extract of *Plumbago zeylanica* Phytotherapy Research 1999; 13(4):346-48.
25. Kaushik P, Dhiman AK. Medicinal Plants and Raw Drugsof India. Bishen Singh Mahendra Pal Singh, Post Box No.137, Dehradun, 2000, xii+1-623.
26. Kaushik P. Haridra (Turmeric). Antibacterial potential Chowkhamba Sanskrit series office, Post Box No. 1008, Varanasi, 2003, 1-124.
27. Mossa JS, El-Feraly LS, Muhammad I. Anti-mycobacterial constituents from *Juniperusprocera*, *Ferula communis* and *Plumbago zeylanica* and their *in vitro* Synergistic activity with isonicotinic acid hydrazide. Phytotherapy Research 2004; 18 (11):934-937
28. Nighantu adarsh, first volume, Shree Vapalal Vaidh, Chaukhambha publication, Varanasi, first edition, page no.797-798.
29. Ravikumar VR et al. [2011] Phytochemical and antimicrobial studies on *Plumbago zeylanica* (L) (Plumbaginaceae). International Journal of Research In Pharmacy and Chemistry.1(2): 185-188.
30. Kodati D R *et al.* [2011] Evaluation of wound healing activity of ethanolic root extract of*Plumbago zeylanica*L. in wistar albino rats. *Asian J. Plant Sci. Res.* 1(2):26-34.
31. Lin LC, Yang LL, Chou CJ, Cytotoxic naphthoquinones and plumbagic acid glucosides from *Plumbago zeylanica*, Phytochem, 62, 2003, 619–622.
32. Merck. Plumbagin. 7697. The Merck Index, 12thed. on CD-ROM, New York, Chapman,1997.
33. Gujar GT. Plumbagin, a naturally occurring naphtho- quinone. Its pharmacological and pesticidal activity. Fitoterapia,1990;59: 387–393 ed. on CD-ROM, New York, Chapman,1997.
34. Melo AM, Jardim ML, Santana CF, Lacet Y, Filho JL, Lima I, Eoncio OG. First observations on the topical and use of primin, plumbagin and mayteni in patients with skin cancer. Revista do Instituto de Antibioticos., 1974; 14:9-16.
35. Modi's Medical Jurisprudence and Toxicology, 23rd edition, Lexis Nexis Butter worths; 2005 page no. 143.
36. Parikh's, text book of Medical jurisprudence, Forensic Medicine and Toxicology, 6th edition, page no 9.37.
37. Rasatarangini, Shree Sadanan Sharma, Editing by Pandit Kashinath Shastri, 11 edition, Taranga 24; 575.
38. Abdul KM, Rachender RP, Modulatory effect of plumbagin of macrophage functions in Balb/c mice. I. Potentiation of macrophage bactericidal activity Immunpharmacol, Pub Med, 30 (3), 1995, 231-236.
39. Zahin M, Aqil F, Ahmad I (2009). The in vitro antioxidant activity and total phenolic content of four Indian medicinal plants. Int. J. Pharma. Pharm. Sci., 1: 89-95.
40. Poosarla, Athota RR (2007). Alleviation of Collagen-induced Arthritis by *Plumbago zeylanica*in Mice. Pharma. Bio., 45: 54-59.
41. Nguyen AT, Malonne H, Duez P, Faotre RV, Vanhaelen M, Fontaine J et al. Cytotoxic constituents from Plumbago zeylanica. Fitoterapia 2004; 75(5):500-504.
42. Teshome K, Mariam TG, Asres K, Perry F, Engidawork E (2008). Toxicity studies on dermal application of plant extract of *Plumbago zeylanica* used in Ethiopian traditional medicine. J. Ethnopharmacol, 117: 236-248.
43. Christudas S, Veeramuthu D, Paul A, SavarimuthuI, Antidiabetic effect of plumbagin isolated from Plumbago zeylanica L. root and its effect on GLUT4 translocation in streptozotocin-induced diabetic rats, Food and Chemical Toxicology, 50, 2012, 4356-4363.
44. Mehmood Z, Ahmad I, Mohammad F and Ahmad S. Indian Midicinal plant: A potential source for anticandidal drug. Pharmaceutical Biology 1999; 37(3):237-242.
45. Marian TG, Neubert R, Schmidt PC, Wutzler P, Schmidt M. Antiviral activity of some Ethiopian medicinal plants used for the treatment of dermatological disorders. Journal of Ethnopharmacology 2006; 104(1-2):182-18.
46. Nguyen AT, Malonne H, Duez P, Faotre RV, Vanhaelen17. Paiva SR, Marques SS, Figueiredo MR, Kaplan MAC. Plumbaginale: A Pharmacological approach. Florestae Ambiente 2003; 10:98-105.
47. Alpana R (1996). Effect of *Plumbago zeylanica* in hyper-lipidaemic rabbits and its modification by vitamin E. *Indian J. Pharmaco.,* 28: 161-166.

Cite this article as:
Neelam arya, Anita Sharma. The Therapeutic and Toxicological Effect of Chitrak (Plumbago Zeylanica L.)- A Review. AYUSHDHARA, 2015;2(4):259-264.
Source of support: Nil, Conflict of interest: None Declared